Comparison of SeaWinds scatterometer data with a hydrologic process model for the assessment of snow melt dynamics

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The use of remote sensing observations for hydrological purposes is of particular interest in high latitude environments where in situ observations are sparse. Spaceborne scatterometer data have the potential for monitoring freeze/thaw transitions and associated processes, and have various attractive attributes including frequent overpasses and all-weather capability. The occurrence of freeze/thaw transitions over large regions has profound impacts on land-atmosphere exchange processes and on regional ecological and hydrologic characteristics. For example, when there is significant snow accumulation during winter followed by subsequent snowpack melt over frozen ground, catastrophic flooding can occur with resultant loss of life and property. Therefore, the possible usefulness of microwave backscatter measurements provided by sensors like the SeaWinds scatterometer on board QuikSCAT (operational since Summer 1999), is of particular interest in the monitoring of snow melt processes and hydrologic modeling.

We simulate snow conditions over Alaska using the Variable Infiltration Capacity (VIC) hydrologic process model at ½ degree spatial resolution for Fall and Spring seasons of September 1999 through May 2001, and compare the simulations with backscatter measurements from the Ku-band SeaWinds scatterometer. Model-predicted hourly snow surface temperature and snow liquid water content are correlated with snow melt and the corresponding backscatter response during some selected events. At selected sites, the time series trend of daily average backscatter during periods of snow melt loosely relates to occurrences of daytime temperature exceedances of 0° C. While diurnal variation in backscatter corresponds to melt and re-freeze processes, the early AM and mid PM QuikSCAT overpass times are not consistently optimal for identification of subtle melt signals, which usually occur in mid-afternoon. The scatterometer data are capable of detecting broad scale seasonal freeze-melt transitions, however challenges remain in extracting the sub-daily information that is critical for hydrologic updating of shorter term freeze-thaw excursions across complex landscapes from scatterometer observations.

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